



Results of forest insect and disease surveys in the NORTH CENTRAL REGION of Ontario, 1991

CARRIED OUT BY THE GREAT LAKES FORESTRY CENTRE IN COOPERATION WITH
THE ONTARIO MINISTRY OF NATURAL RESOURCES

H.J. Evans and S. Melbourne

Miscellaneous Report No. 112



Forestry
Canada

Forêts
Canada

Canada

FORESTRY CANADA, ONTARIO REGION

Ontario Region is one of six regional establishments located across Canada and operated by Forestry Canada. The overall objective of Forestry Canada is to promote the preservation, enhancement and wise use of a healthy, attractive and bountiful forest resource and terrestrial environment for the economic and social benefit of all Canadians. Ontario Region pursues this objective by conducting two major programs: research and technical services and forestry development. Both programs address major problems affecting forest management and the forest environment primarily in Ontario, but because of the transprovincial nature of the forest resource, many elements of our research program are of national significance.

Ontario Region specializes in research in forest production, forest protection, forest environment and forest utilization. These programs deal directly with the issue of maintaining and enhancing the resource supply. Activities range from basic to applied and developmental research, and include a significant technology transfer component.

Major activities in forestry development include federal management responsibility for federal-provincial forest management agreements, participation in the National Forestry Statistics program and forest economics research.

Close working relationships are maintained with the Ontario Ministry of Natural Resources, the forest industry, educational institutions specializing in forestry and the biological sciences, and other forestry organizations within the province. Ontario Region is represented on the Ontario Forestry Council and the Ontario Forestry Research Committee, which have responsibility for co-ordinating forestry research in Ontario.

It is recognized that forested land must be managed in the best public interest, not only for the wood production essential to our economy, but also for the recreational purposes that are so important to our social well-being. This must be achieved in a manner that will maintain or improve the quality of the forest environment and preserve it for generations to come.

**RESULTS OF FOREST INSECT
AND DISEASE SURVEYS IN THE
NORTH CENTRAL REGION OF ONTARIO
1991**

Forest Districts:
Atikokan, Geraldton, Nipigon, Terrace Bay and Thunder Bay

H. Evans and S. Melbourne

**FORESTRY CANADA
ONTARIO REGION
GREAT LAKES FORESTRY CENTRE**

1992

MISCELLANEOUS REPORT NO. 112

©Minister of Supply and Services Canada 1992

Catalogue No. Fo29-8/112E

ISBN 0-662-19429-2

ISSN 0832-7130

Copies of this publication are available at no charge from:

Communications Services
Forestry Canada, Ontario Region
Great Lakes Forestry Centre
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

Microfiches of this publication may be purchased from:

Micro Media Inc.
Place du Portage
165, Hôtel-de-Ville
Hull, Quebec
J8X 3X2

SURVEY HIGHLIGHTS

This report summarizes forest insect and disease problems encountered during the 1991 field season in the Ontario Ministry of Natural Resources' (OMNR) North Central Region. It also records the results of special surveys and tree damage that resulted from abiotic causes.

Infestations by the spruce budworm and the forest tent caterpillar again dominated insect activity in the region. Damaging levels of several plantation insects (the white pine weevil, eastern pine shoot borer and yellowheaded spruce sawfly) were reported in some instances.

Scleroderris canker, Armillaria root rot and western gall rust were three of the diseases that continued to cause problems with trees in the region. Abiotic problems included ash dieback and drought damage.

A survey of some of the seed orchards in the region, which replaced the annual survey of coniferous plantations in 1990, was repeated this year. Examinations were also made at the provincial tree nursery and the acid rain monitoring plots. The annual gypsy moth pheromone trapping program resulted in a positive result for the second consecutive year.

The format for this report remains unchanged from that of 1990. Insects and diseases are categorized as follows:

Major Insects or Diseases

capable of causing serious injury to or death of living trees or shrubs

Minor Insects or Diseases

capable of causing sporadic or localized injury but not usually a threat to living trees or shrubs

Other Forest Insects / Diseases (Tables)

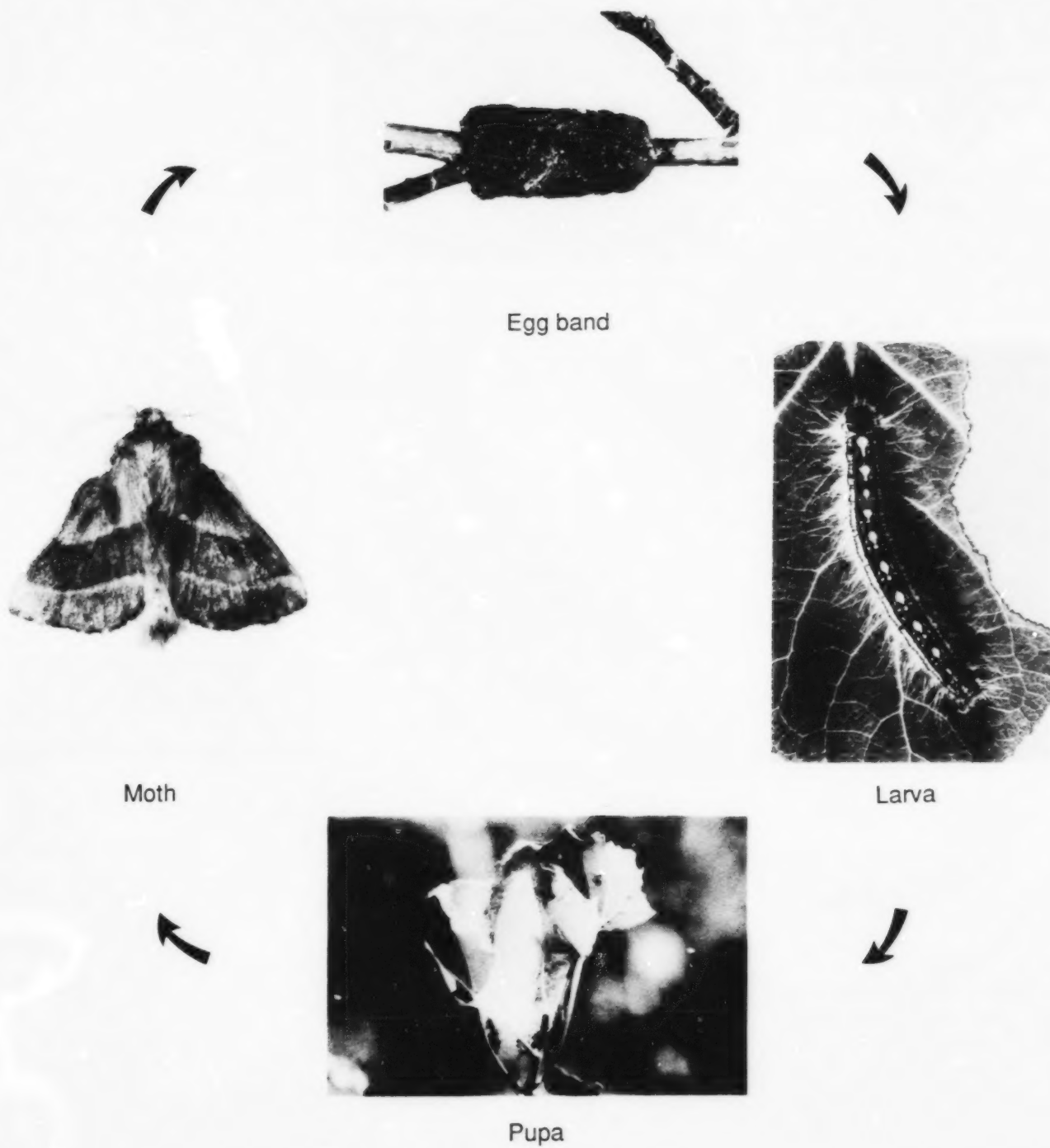
These tables provide information on two types of pest:

- 1) those that are of minor importance and have not been known to cause serious damage to forest trees, and
- 2) those that are capable of causing serious damage but, because of small populations or for other reasons, did not cause serious damage in 1991.

The authors gratefully acknowledge the co-operation and assistance of personnel in the OMNR and of various forest companies in the region.

H. Evans
S. Melbourne

FRONTISPIECE



Life cycle of the forest tent caterpillar (*Malacosoma disstria* Hbn.)

TABLE of CONTENTS

	page
INSECTS	
<i>Major Insects</i>	
Eastern Spruce Budworm, <i>Choristoneura fumiferana</i> (All districts)	1
Jack Pine Budworm, <i>Choristoneura p. pinus</i> (Thunder Bay, Nipigon, Geraldton and Terrace Bay districts)	5
Eastern Pine Shoot Borer, <i>Eucosma gloriola</i> (Atikokan, Thunder Bay and Nipigon districts)	5
Birch Leafminer, <i>Fenusa pusilla</i> (All districts)	6
Forest Tent Caterpillar, <i>Malacosoma disstria</i> (All districts)	7
Yellowheaded Spruce Sawfly, <i>Pikonomia alaskensis</i> (All districts)	10
White Pine Weevil, <i>Pissodes strobi</i> (All districts)	11
Spearmarked Black Moth, <i>Rheumaptera hastata</i> (Atikokan and Thunder Bay districts)	12
Other forest insects	13
TREE DISEASES	
<i>Major Diseases</i>	
Armillaria Root Rot, <i>Armillaria ostoyae</i> (All districts)	15
Sclerotinia Canker, <i>Gremmeniella abietina</i> (Nipigon, Terrace Bay and Geraldton districts)	15
<i>Minor Diseases</i>	
Pine Needle Rust, <i>Coleosporium asterum</i> (Geraldton, Thunder Bay and Atikokan districts)	15
Tar Spot Needle Cast, <i>Davisonmycelia ampla</i> (Atikokan, Geraldton, Nipigon, Terrace Bay and Thunder Bay districts)	15
Western Gall Rust, <i>Endocronartium harknessii</i> (All districts)	15
Other forest diseases	16
ABIOTIC DAMAGE	
Ash Dieback (Thunder Bay District)	17
Drought (All districts)	17
FOREST HEALTH	
Acid Rain National Early Warning System (ARNEWS) (Thunder Bay, Geraldton and Terrace Bay districts)	17
White Birch Health (Terrace Bay District)	18
(cont'd)	

TABLE of CONTENTS (concl.)

	<i>page</i>
SPECIAL SURVEYS	
Gypsy Moth, <i>Lymantria dispar</i> (All districts)	19
Forest Tree Nursery Report (Thunder Bay District)	19
Seed Orchard Survey (Thunder Bay and Geraldton districts)	20
Climatic Data (Thunder Bay and Geraldton districts)	21
APPENDIX	
Spruce budworm damage in North Central Region	

INSECTS

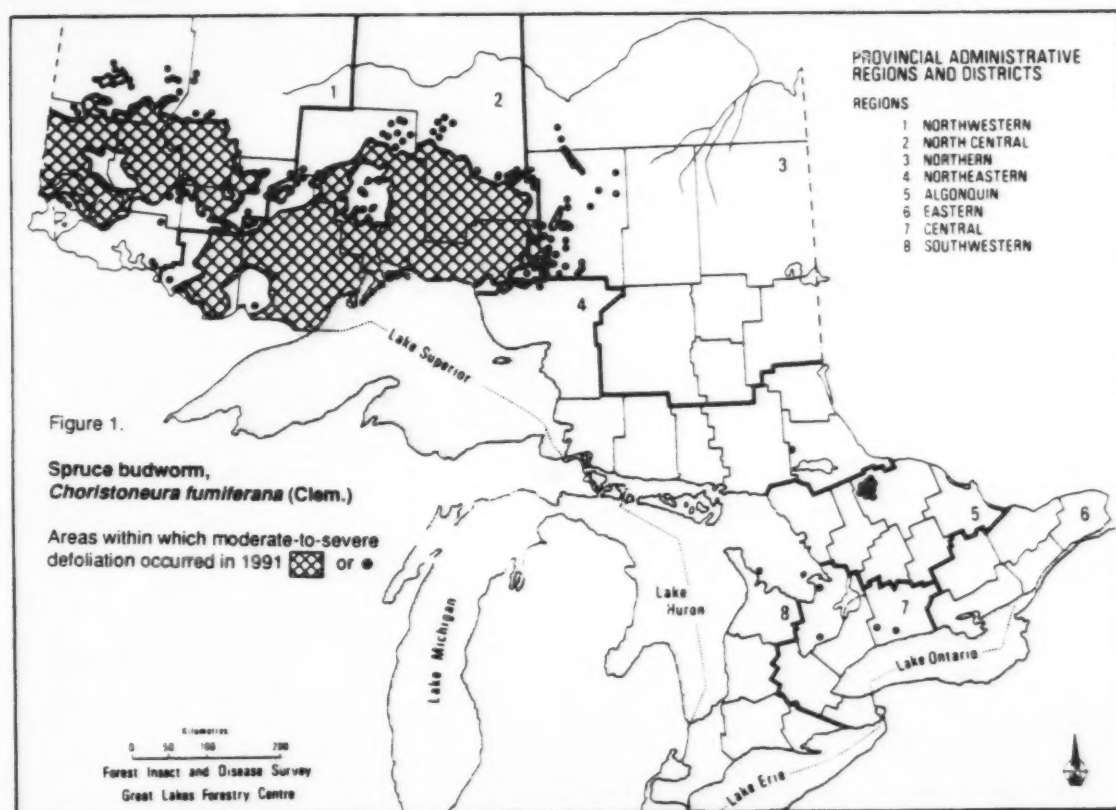
Major Insects

Eastern Spruce Budworm, *Choristoneura fumiferana* (Clem.)

The spruce budworm outbreak in Ontario increased in area for the third consecutive year. The total gross area of moderate-to-severe defoliation increased from 6,783,261 ha in 1990 to 9,065,781 ha this year. The bulk of the infestation remains in the Northwestern and North Central regions, and every district except Dryden experienced a net increase in the total area infested. The two large areas infested in 1990 merged to form a single area that stretches from the Manitoba border eastwards to the western part of Hearst District, Northern Region, and to the northwestern corner of Wawa District, Northeastern Region. Outside of the main body of continual infestation, scattered, relatively

small areas of damage were detected in the Moosonee and Hearst districts, Northern Region; in the Sault Ste. Marie, Sudbury, Wawa and North Bay districts, Northeastern Region; in Algonquin Park District, Algonquin Region; in the Lindsay, Maple and Huronia districts, Central Region; and in Wingham District, Southwestern Region (Fig. 1). The largest area of expansion, an additional 2,017,167 ha of moderate-to-severe defoliation, occurred in North Central Region, where sizeable increases were recorded in each district (Table 1, Fig. 2).

Spruce budworm larval development was rapid this year because of warmer than normal temperatures in the latter half of May and in early June. Balsam fir (*Abies balsamea* [L.] Mill.) and white spruce (*Picea glauca* [Moench] Voss) were the hosts most visibly affected in most areas. Black spruce (*P. mariana* [Mill.] B.S.P.) also sustained

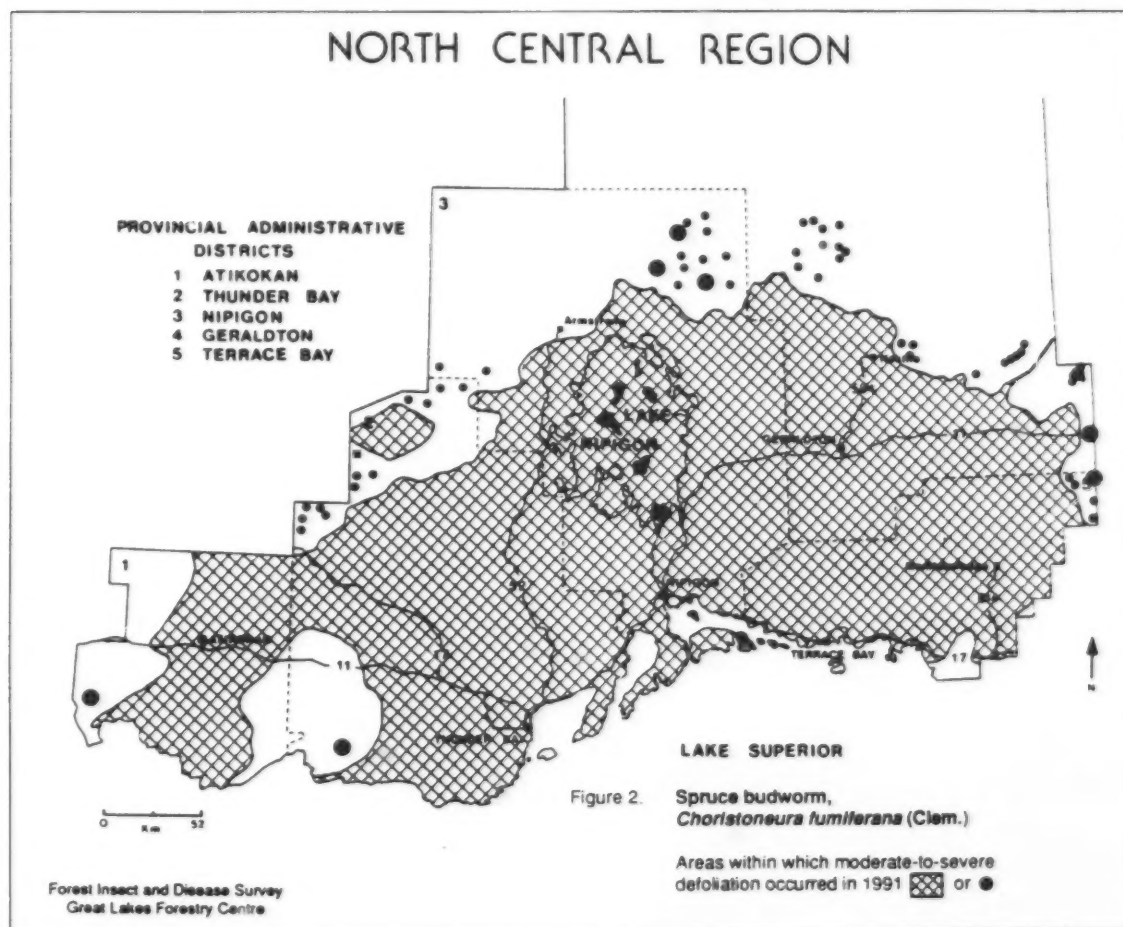


significant damage in many areas. The damage on this species was often visible from the air, particularly in the Nipigon, Terrace Bay and Geraldton districts. Even when growing with jack pine (*Pinus banksiana* Lamb.), black spruce was often damaged. Samples from such mixed stands in the

Brightsands area, Thunder Bay District, and near Margo Lake, Geraldton District, had 50 and 65% defoliation, respectively. Less defoliation was noted on tamarack (*Larix laricina* [Du Roi] K. Koch) in 1991 than in the previous year.

Table 1. Gross area of current moderate-to-severe defoliation by the spruce budworm in the North Central Region of Ontario from 1987 to 1991.

District	Area of moderate-to-severe defoliation (ha)				
	1987	1988	1989	1990	1991
Atikokan	808,508	578,464	482,208	410,377	550,264
Geraldton	211,954	13,956	389,750	493,011	1,146,368
Nipigon	987,526	605,741	940,513	1,087,868	1,403,210
Terrace Bay	528,555	260,393	624,724	761,251	1,081,938
Thunder Bay	1,101,963	376,395	597,382	1,273,723	1,861,617
Total	3,638,506	1,834,949	3,034,577	4,026,230	6,043,397



In all, 261 locations across the region were sampled in the annual egg-mass survey used to forecast the expected infestation in 1992. A comparison was made with the 1990 results at 158 common locations and this indicated an overall decrease of 8%. The average egg-mass density was highest in Geraldton District, followed by Terrace Bay District; this demonstrates the eastward advance of the outbreak (Table 2). The sample locations with the 1991 foliar damage, the forecast for 1992 and the accumulated hazard rating are summarized in the Appendix.

Spruce budworm-associated tree mortality continued to spread in all districts of the region. The area within which balsam fir mortality occurs now totals 2 849,660 ha. Much of this increase occurred in Nipigon District, where the area of mortality increased by 236,826 ha to 550,576 ha in 1991 (Table 3, Fig. 3). Results of tree mortality counts for balsam fir and white spruce are listed in Table 4.

The infested area in Atikokan District enlarged in spite of the widespread high mortality of balsam fir and the fact that there are large areas of discontinuous budworm type in the district. Although the infestation boundaries are similar to those of 1990, the Highway 11 corridor became re-infested in 1991, as did part of Quetico Park. The forecast for 1992 is that moderate-to-severe defoliation will continue at some locations but declines are expected at others, and this may signify the breakup of the infestation in this district.

In Thunder Bay District, the infestation expanded to include many areas that were uninfested in 1990. These areas include the Highway 17 corridor from English River to Raith;

the forested land type in the mainly agricultural area south of the City of Thunder Bay; and in the Shebandowan-Kekekuab-Batwing-Flatrock lakes area. Expanding areas of balsam fir mortality include an area west of Pakashkan Lake and south-east of Dog Lake in Jacques Township. Plots in these areas have 23% (Fallscamp Lake) and 26% (Jacques Township) mortality, respectively.

Table 3. Gross area within which balsam fir whole-tree and top mortality occurred in 1990 and 1991 in the North Central Region of Ontario.

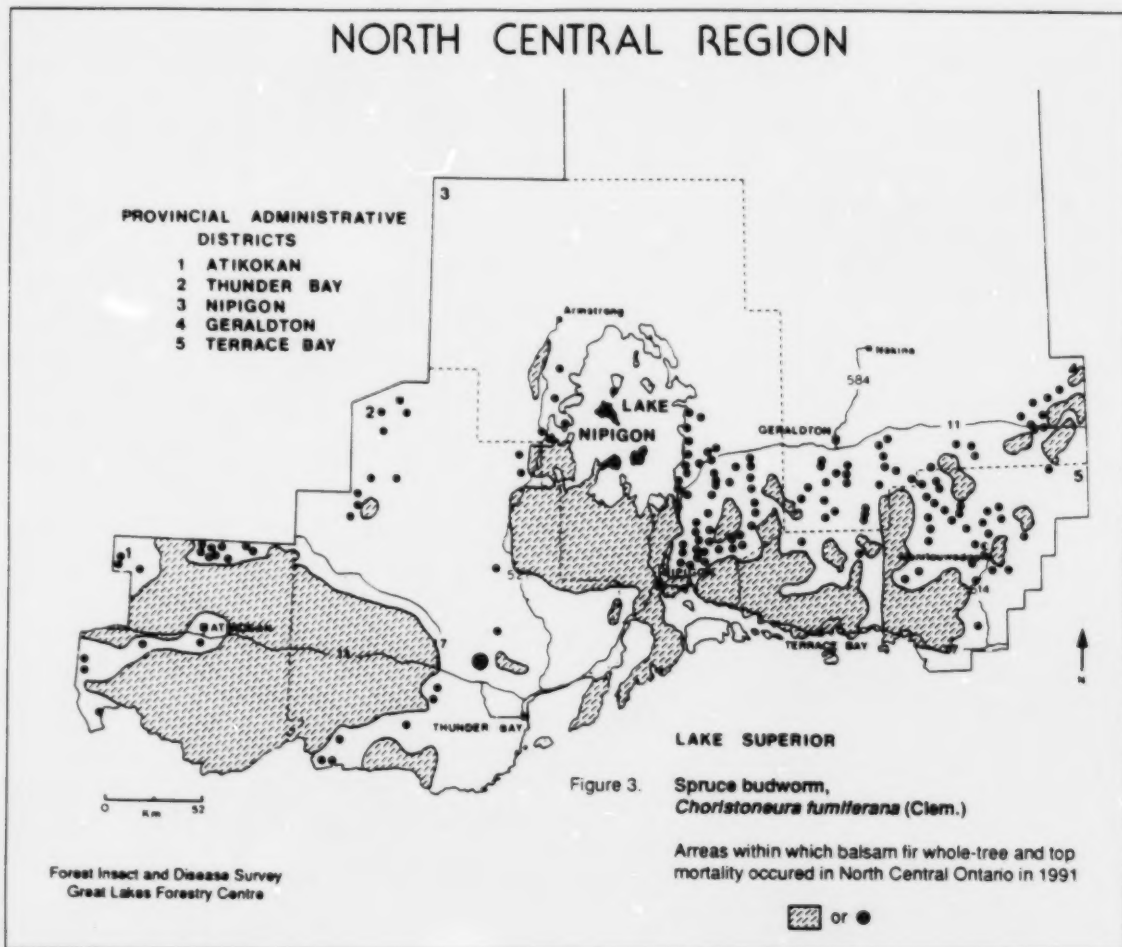
District	Total area (ha)		Increase (%)
	1990	1991	
Atikokan	861,785	867,425	0.6
Geraldton	47,220	68,595	45.3
Nipigon	313,750	550,576	75.5
Terrace Bay	328,504	536,740	63.4
Thunder Bay	757,890	826,324	9.0
Total	2,309,149	2,849,660	23.4

The southern boundaries of the outbreak in Nipigon District remain unchanged; however, an expansion occurred in the northern part of the district. This is most evident north and northeast of Lake Nipigon, where the infestation now extends well beyond the Canadian National Railway (CNR) main line. Smaller pockets were mapped on the southern side of Mojikit Lake and in an area on the northern side of the Ogoki Reservoir. The area of balsam fir mortality now includes almost all of the area south of Lake Nipigon. It extends as far north as Pillar Lake, just south of Armstrong on the western side of Lake Nipigon; as far north as Barbara Township, on the eastern side of the lake; and includes many of the islands in the lake. The egg-

Table 2. Spruce budworm egg-mass densities in the North Central Region of Ontario in 1990 and 1991.

District	Number of locations	Number of locations with increase	Average egg-mass density per 9.29 m ² of branch		% Change
			1990	1991	
Atikokan	15	10	145.2	239.6	+65
Geraldton	22	9	651.0	529.3	-19
Nipigon	24	5	675.6	331.8	-51
Terrace Bay	36	18	321.4	401.2	+25
Thunder Bay	6	31	271.7	305.7	+12
Over all	158	73	385.2	356.3	-8

NORTH CENTRAL REGION



mass densities are down considerably (-51%) from 1990 to 1991. This is particularly noticeable in the southern part of the district, where the severity of the defoliation may be somewhat reduced in 1992.

The largest overall increase in the area affected was in Geraldton District. The main body of the infestation, as in Nipigon District, extends well north of the CNR main line and pockets of infestation were found as far north as Ogoki Lake and along the Flint, Kenogami and Pagwachuan rivers in the eastern part of the district. New areas of mortality are relatively small (21,375 ha) and they are confined to the southwestern corner of the district, south of the town of Longlac and in the Caramat area. As previously mentioned, the greatest increase in egg-mass densities was in this

district. The intensity of the infestation is expected to increase, but it is unlikely that the boundaries will expand.

Moderate-to-severe defoliation occurred over almost the entire area of Terrace Bay District. The intensity of the damage decreased somewhat in 1991, in part because of extensive balsam fir mortality in many stands in the district. Mortality has progressed very rapidly in some areas. For example, the mortality level at the Lyne Lake plot rose from 16% in 1989 to 96% in 1991. New areas of balsam fir mortality, a total of 208,236 ha, were mapped in the district in 1991. Moderate-to-severe defoliation will likely prevail in 1992, particularly in the eastern half of the district, while reductions may be noticed in the western half.

Table 4. North Central Region: Summary of spruce budworm-associated tree mortality, based on ground checks for the past 3 years.

Location	Host ^a	Tree mortality (%)		
		1989	1990	1991
<i>Atikokan District</i>				
Seine River	bF	82	98	—
<i>Geraldton District</i>				
Hwy 11, east of Nibs Lake	bF	80	93	—
Nibs Lake impact plot	bF	24	36	63
Catlonite Road	bF	—	—	23
<i>Nipigon District</i>				
Adamson Township	bF	25	28	40
Black Sturgeon Lake	bF	19	44	87
Booth Township	bF	—	11	29
	wS	—	12	59
Cedar Mountain Road	bF	42	49	86
	wS	—	35	58
Kabitotikwia Lake	bF	9	24	52
	wS	—	0	12
Lett Township	bF	—	15	30
Limestone Lake	bF	—	9	35
Lyon Township	bF	—	14	38
McIvor Township	bF	4	19	75
	wS	—	0	8
McKirdy Lake	bF	—	25	34
Nipigon Township	bF	9	11	63
Polly Lake Impact Plot	bF	0	10	55
	wS	0	0	0
Purdom Township	bF	—	2	5
	wS	—	12	48
Shillabeer Creek	bF	35	36	54
Squawk Lake Road	bF	—	7	44
Squawk Lake Road	bF	—	4	45
Trapnarrows Lake	bF	—	8	46
<i>Terrace Bay District</i>				
Grain Township	bF	56	60	75
Kagiano Lake Road	bF	—	7	38
Lyne Lake Road	bF	16	85	96
Yesno Township	bF	—	44	90
<i>Thunder Bay District</i>				
Burchell Lake	bF	82	83	87
Cheeseman Lake	bF	59	61	75
	wS	12	12	12
Conacher Township	bF	79	88	96
Fallscamp Lake	bF	—	9	23
Jacques Township	bF	—	9	26
Mountain Lake	bF	13	26	56
Open Bay				
(Lac des Mille Lacs)	bF	14	23	42
Sibley Township	bF	4	7	20
Sibley Township	bF	—	5	12
Sump Lake	bF	37	41	47

^a bF = balsam fir, wS = white spruce

Jack Pine Budworm, *Choristoneura p. pinus* Free.

A new outbreak of this pest of jack pine was detected in 1991. The infested area straddled the boundary between Thunder Bay District, North Central Region, and Ignace District, Northwestern Region, in the area south and west of Metionga Lake. The total area of moderate-to-severe defoliation was 2,591 ha, of which 870 ha was in Thunder Bay District. The affected stands bordering on Little Metionga and Dove lakes consist mostly of mature timber and contain a high component of jack pine. This was the only area of significant damage in the region in 1991, but increased numbers of larvae were noted at several other locations. For example, 13% of the saplings at the Bluebird Lake family test site and 100% of the saplings in a plantation in Ledger Township, Nipigon District, had trace populations of the pest.

Egg-band samples were taken at twelve locations in four districts to help predict population levels for 1992 (Table 5). It appears that the infestation in the Little Metionga-Dove lakes area will continue, but more intensive sampling would be required to determine if this outbreak will expand. Other positive sample locations as far east as the Goldfield Road, Geraldton District, indicate that there may be more areas of infestation in 1992.

Eastern Pine Shoot Borer, *Eucosma gloriola* Heinr.

Extremely high population levels of this insect were recorded in jack pine plantations throughout most of the Atikokan and Thunder Bay districts. The greatest damage occurred at the Fallscamp Lake jack pine family test, Thunder Bay District, where 48.5% of the leaders were affected by this pest. Leader damage ranging from 17.0 to 43.5% was recorded at nine other locations in these two districts (Table 6). Lower population levels occurred in Nipigon District.

Table 5. North Central Region – Jack Pine Budworm: defoliation estimates and egg-mass counts in 1991 and infestation forecasts for 1992.

Location	Estimated % defoliation in 1991	Total number of egg masses on six 61-cm branch tips	Infestation forecasts for 1992 ^a
<i>Geraldton District</i>			
Goldfield Road	8	3	M
<i>Nipigon District</i>			
Pifher Township	0	0	N
Sandra Township	0	3	M
<i>Terrace Bay District</i>			
Goldfield Road	19	1	L
<i>Thunder Bay District</i>			
Dove Lake – Stand 148	21	30	H
English River – Stand 80	2	0	N
– Stand 100	2	0	N
– Stand 283	3	1	L
Little Metionga Lake – Stand 362	27	45	H
– Stand 400	45	9	H
Metionga Lake – Stand 6	7	0	N
Pyramid Township	2	0	N

^a N = nil, L = light, M = moderate, H = heavy

Table 6. Damage to jack pine caused by the eastern pine shoot borer in three districts of the North Central Region of Ontario in 1991 (counts based on an examination of a minimum of 150 trees at each location).

Location	Area affected (ha)	Estimated number of trees/ha	Average height of trees (m)	Leaders attacked (%)
<i>Atikokan District</i>				
Windigoostigiwan Lake	8	5,000	2.0	39.0
Turtle Lake	12	4,000	1.6	23.0
<i>Nipigon District</i>				
Obonga Lake	10	4,000	2.7	3.0
<i>Thunder Bay District</i>				
Bluebird Lake	5	2,500	1.3	36.0
Burchell Lake	10	3,000	2.3	43.5
English River	20	2,500	2.1	29.0
Fallscamp Lake	5	2,500	1.3	48.5
Grew River	5	3,500	1.5	34.0
Kakabeka Falls	15	3,730	0.9	17.0
Pace Lake	5	2,800	1.2	26.0
Raith	5	2,500	1.2	20.0

**Birch Leafminer,
Fenusa pusilla (Lep.)**

Birch leafminer damage to white birch (*Betula papyrifera* Marsh.) was again prevalent in some areas of the region. The most significant damage in

forested situations occurred in the southeastern part of Thunder Bay District, where ground and aerial surveys delineated a total of 165 ha of moderate-to-severe defoliation. This damage occurred in Adrian, Marks, O'Connor, Paipoonge and

McIntyre townships. There were 25 ha of similar damage in Nipigon Township, Nipigon District. Extensive damage to fringe trees occurred along 8 km of the Goldfield Road, Terrace Bay District, and along 3 km of roadway in Oakes Township, Geraldton District. Elsewhere, medium and heavy infestations were common on individual trees and small clumps of trees in the Thunder Bay, Nipigon, Terrace Bay and Geraldton districts.

Forest Tent Caterpillar,
Malacosoma disstria Hbn.

There was an even more dramatic increase in the total area defoliated by forest tent caterpillar in 1991 than in 1990. Despite a reduction of the infestation in Atikokan District, the overall area affected in all five districts increased almost fourfold (Table 7, Fig. 4). Trembling aspen (*Populus tremuloides* Michx.) is the most important host in northern Ontario, but in areas of large larval populations, other deciduous trees and shrubs, in particular white birch, were attacked.

Due to an unseasonably warm late May and early June, larval development was almost 3 weeks ahead of normal, resulting in rapid larval growth and early severe defoliation. As an example, larvae averaged 10 mm in length and caused 10% defoliation near Upsala, Thunder Bay District, on 21 May. A week later at the same location, larvae were 28 mm long and caused an average of 70% defoliation. This kind of rapid development even occurred in areas quite far north, and there were a number of locations throughout the region that had 100% foliar damage in early June.

The total area of infestation in Atikokan District decreased considerably in 1991 and was confined to the northern half of the district. The original outbreak along the Highway 11 corridor is breaking up, with only moderate defoliation encountered, whereas severe damage occurred in the northern part of the district.

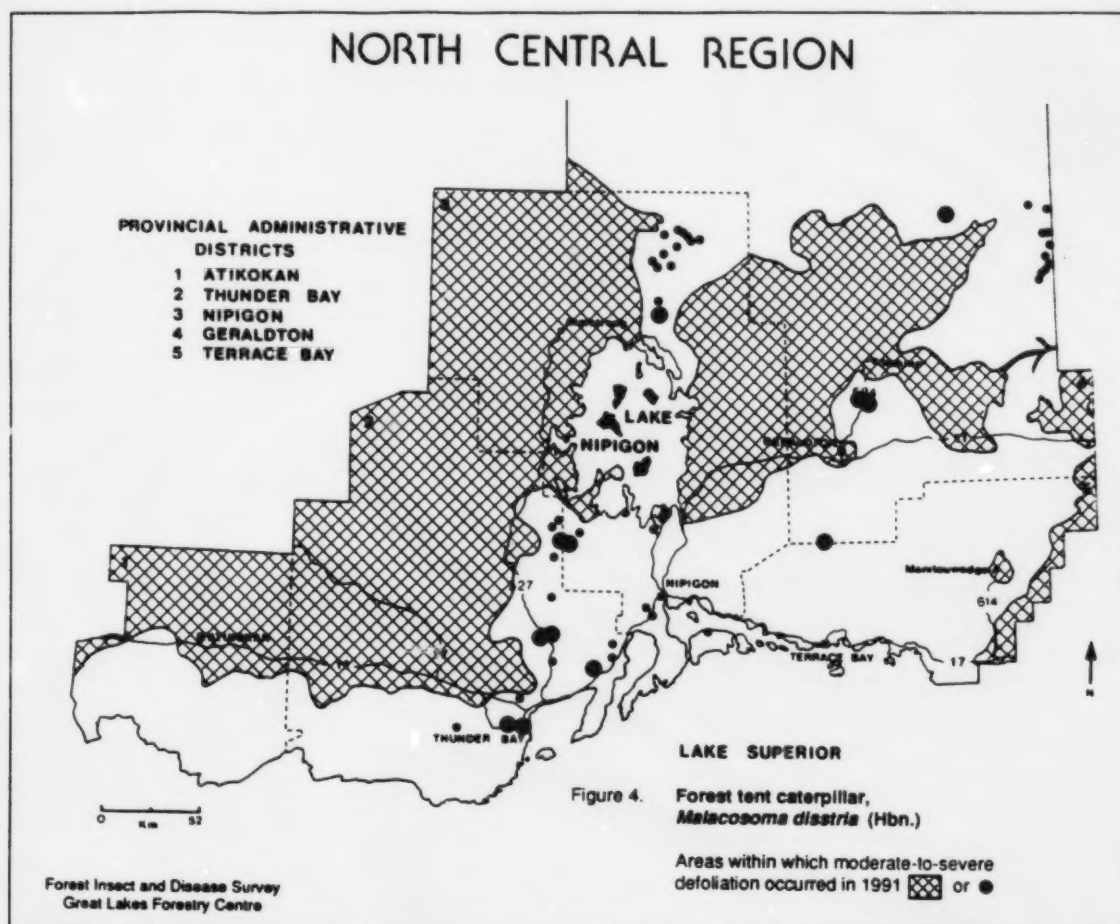
In Thunder Bay District, the northern and western portions of the district were affected, with the southern boundary of the infestation generally being just south of Highway 11, where defoliation was moderate. Damage in the City of Thunder Bay was also moderate. From Lac des Mille Lacs north to the district boundary and east to the infestation boundary, defoliation was generally severe. There were also smaller pockets of moderate-to-severe defoliation in the eastern part of the district.

In Nipigon District, the area infested expanded to more than 11 times that of 1990. The southern boundary of the damage was the southern end of Lake Nipigon, while defoliation in the northwest was apparent up to the district boundary at 51° latitude. This extended east to the Ogoki Reservoir, where it started to break up somewhat. Most of the islands in Lake Nipigon were affected, and there were a few smaller pockets around Red Rock, Kama Bay, Vert Island and St. Ignace Island.

Geraldton District had an even larger proportional increase in the area defoliated, more than 15 times that of 1990. This was due to the large expansion of the infestation north of Highway 11, where the main body of the infestation extended as far north as Ogoki Lake in the west and the Little

Table 7. Gross area of current moderate-to-severe defoliation by the forest tent caterpillar in the North Central Region of Ontario from 1987 to 1991.

District	Area of moderate-to-severe defoliation (ha)				
	1987	1988	1989	1990	1991
Atikokan	1,770	28,160	423,404	816,998	565,366
Geraldton	0	0	180	74,730	1,227,585
Nipigon	0	560	8,535	176,686	1,955,390
Terrace Bay	380	690	4,255	35,065	125,284
Thunder Bay	280	4,230	19,739	310,307	1,716,802
Total	2,430	33,640	456,113	1,413,786	5,590,427



Current River in the east. Numerous stands of aspen were affected along riverbanks adjacent to the Hearst District boundary as far north as 51° latitude. There was also a large pocket of affected aspen in the extreme northwestern corner of the district, an extension of the adjoining infestations in Nipigon District and Sioux Lookout District, Northwestern Region. The southernmost pocket was an area at the southern end of Long Lake straddling the Terrace Bay District boundary; this infestation may well expand in 1992, as it is in a newly infested area.

Terrace Bay District saw an expansion of the affected area from highways 17 and 614 in a north-east direction adjoining the Wawa District, North-eastern Region, and Hearst District, Northern Region, boundaries up to the southeastern corner of Geraldton District. There was also a large pocket of

defoliation surrounding the town of Manitowadge.

To forecast population densities and defoliation probabilities for 1992, 56 locations were sampled for overwintering egg bands. Forecasts show that moderate-to-severe defoliation will be prevalent through most of the current infestation, with some likely expansion into new areas (Table 8, Fig. 5). Atikokan District showed a definite decline in the number of egg bands, so the infestation in this area will continue to decline, whereas other areas, particularly those in the northern portions of the Geraldton and Nipigon districts, will likely sustain more severe defoliation in 1992. This forecast may also be affected by weather conditions and the appearance of the pupal parasite *Arachnidomyia aldrichi* (Park.).

Table 8. Forest tent caterpillar egg-band counts on trembling aspen in the North Central Region of Ontario in 1991, with infestation forecasts for 1992.

Location	Average DBH of trees (cm)	Average number of egg bands per tree	Infestation forecast for 1992
<i>Atikokan District</i>			
Flanders	12	1.3	Moderate
French Lake	12	6.3	Severe
Grey Trout Lake	14	4.3	Moderate
Hardtack Road	11	3.7	Moderate
Highway 11 - Lerome Lake	10	3.0	Moderate
Ramsay-Wright Township	22	10.7	Severe
<i>Geraldton District</i>			
Ashmore Township	13	41.0	Severe
Castlebar Lake Lodge	11	31.0	Severe
Chipman Lake Road	12	56.0	Severe
Exton Township	12	65.0	Severe
Fernow Lake	10	11.5	Severe
Goldfield Road, Rogers Lake	12	22.0	Severe
Highway 584: Biscuit Lake	10	1.7	Light
Highway 11: west of North Pagwachuan River	9	0.7	Light
Highway 1 Pagwachuan River	14	25.0	Severe
Klotz Lake, Highway 11	12	9.7	Severe
<i>Nipigon District</i>			
Black Sturgeon Lake (northern end)	10	28.0	Severe
Eva Township, Highway 580	12	18.0	Severe
Gorge Creek Road	10	9.0	Severe
Highway 11 - Orient Bay	11	27.0	Severe
Highway 527 - Gull Bay	13	39.0	Severe
Highway 527 - Kopka River	17	57.0	Severe
Highway 527 - McKenzie Lake	14	33.0	Severe
Ledger Township	8	1.3	Light
Legault Township	12	27.0	Severe
Lett Township	12	2.0	Moderate
Oskawe Lake	11	6.3	Severe
Pifher Township	13	86.0	Severe
Pikitigushi Lake Road	13	72.0	Severe
Red Rock	12	4.7	Moderate
Shillabeer Lake	14	14.5	Severe
Sturgeon River Road	11	3.0	Moderate
Walters Township	12	24.0	Severe
<i>Terrace Bay District</i>			
Highway 614, Leslie Township	13	13.0	Severe
Highway 614, Bomby Township	11	23.0	Severe
Lemay Road, White Otter River	12	1.0	Light
Pic Township	11	0.3	Light

(cont'd)

Table 8. Forest tent caterpillar egg-band counts on trembling aspen in the North Central Region of Ontario in 1991, with infestation forecasts for 1992 (concl.).

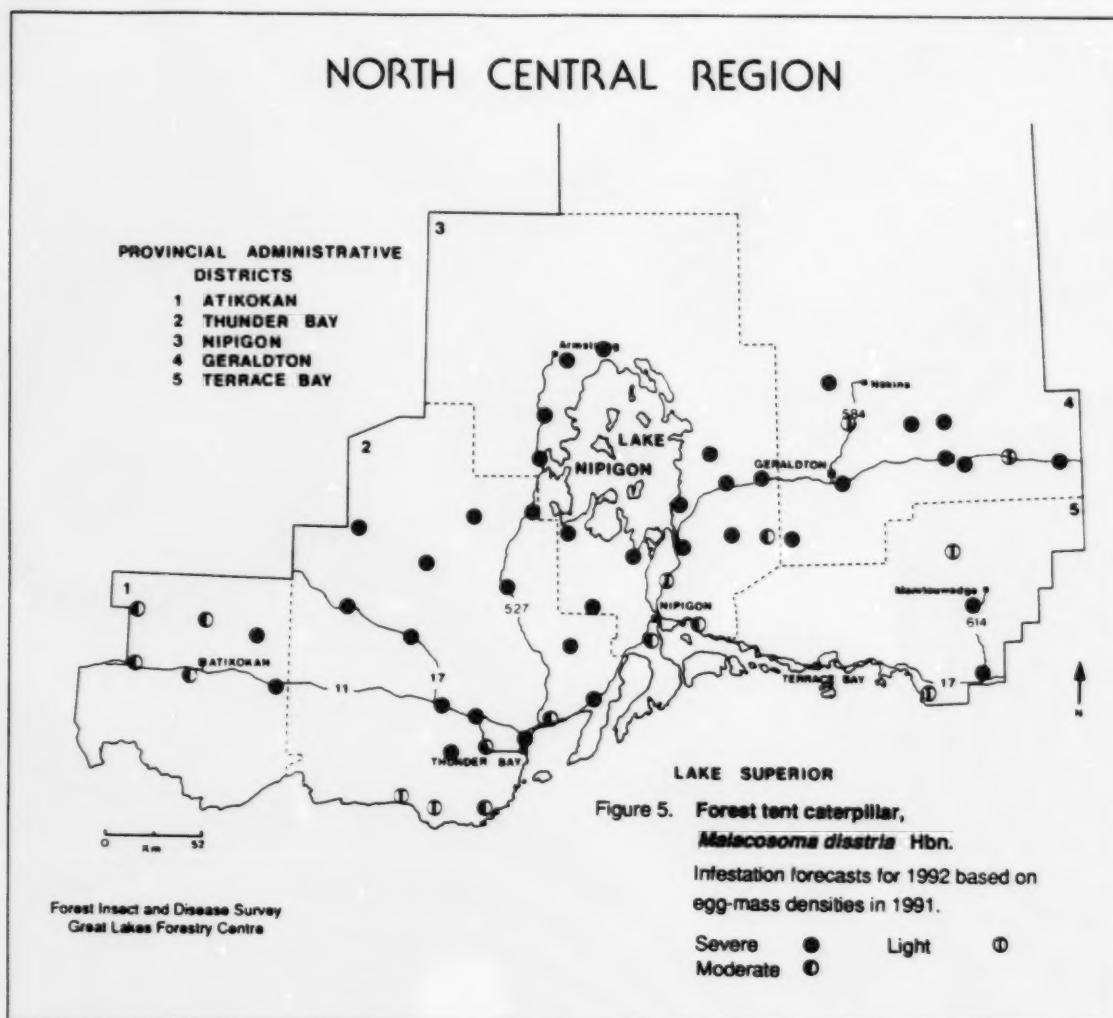
Location	Average DBH of trees (cm)	Average number of egg bands per tree	Infestation forecast for 1992
<i>Thunder Bay District</i>			
Aldina Township	14	7.3	Severe
Blackwell Township	14	22.5	Severe
City of Thunder Bay	13	7.0	Severe
Crooks Township	14	3.0	Moderate
Fallis Township	13	7.3	Severe
Graham Road (Wawang Lake)	13	56.0	Severe
Hartington Township	15	0.3	Light
Highway 527 - Hicks Lake	14	12.0	Severe
Highway 527 - Rinker Lake	11	42.0	Severe
Jack Lake	15	71.0	Severe
Jacques Township	13	12.5	Severe
Kabitotikwia Lake	12	14.5	Severe
MacGregor Township	11	3.3	Moderate
McTavish Township	10	17.5	Severe
Mooseland River	17	31.0	Severe
Mountain Lake Road	13	0.7	Light
Paipoonge Township	14	5.7	Moderate
Sunshine	10	18.5	Severe
Upsala Township	13	7.3	Severe

Yellowheaded Spruce Sawfly,
Pikonema alaskensis (Roh.)

Large numbers of yellowheaded spruce sawfly larvae were once again encountered throughout much of the Atikokan and Thunder Bay districts. A new infestation was reported in Nipigon District even as populations declined in most areas of the Geraldton and Terrace Bay districts. An exception in the Terrace Bay District was noted in Roberta Township, where defoliation averaged 65% on young white spruce and black spruce and scattered tree mortality occurred due to repeated attacks. In Geraldton District, cumulative mortality now totals 80% across a 0.5-ha area within a black spruce plantation near Burrows Lake, but population levels dropped markedly in 1991, thereby limiting defoliation to 10%. In the Thunder Bay District, there were two areas in which plantation trees sustained significant damage. A 0.5-ha area of 2.5-m black spruce near Camp 230 and a 0.1-ha

area of 2.0-m white spruce along the Boreal Road both averaged 60% foliar damage.

Damage to roadside and fringe forest trees was observed along all the major roads radiating from the City of Thunder Bay. Damage occurred along Highway 11, west to the Flanders area, Atikokan District; along Highway 17, west to the Upsala area; north along Highway 527, to the Camp 230 area; east along Highway 11-17, to the Hurkett area, Nipigon District; and along rural roads in the immediate area of Thunder Bay. Damage in the affected areas was highly variable. For example: in the town of Atikokan, eight ornamental 1.0-m white spruce averaged 60% defoliation; near Upsala, Thunder Bay District, thirty 2.0-m black spruce averaged 60% damage; and at Hurkett, Nipigon District, thirty-five 2.0-m white spruce averaged 15% defoliation, with damage ranging as high as 90%.



Shoreline trees were also heavily damaged at some locations. Severe (as high as 100%) foliar damage occurred on black spruce at McGinnis, Greenwood, Hood and Crayfish lakes, Thunder Bay District, and on white spruce at Pickerel and French lakes, Atikokan District.

White Pine Weevil,
Pissodes strobi (Peck)

White pine weevil populations remained at similar levels to those reported in 1990. The highest incidence on spruce was recorded in a 2.3-m white spruce plantation in Davies Township,

Terrace Bay District, where 22.6% of the leaders were affected. The heaviest damage on jack pine occurred on the Burchell Lake Road, Thunder Bay District, where leader damage averaged 16.5%. In general, spruce plantations appear to be much more susceptible than jack pine plantations to attack by this insect in the eastern half of the region. The result of surveys for leader damage from this pest are summarized in Table 9. In addition, there were nine locations at which no weevils were observed, including six spruce plantations in Thunder Bay District and three jack pine plantations in the eastern half of the region.

Table 9. Damage caused by the white pine weevil in five districts in the North Central Region of Ontario in 1991 (counts based on an examination of at least 150 trees at each location).

Location	Area affected (ha)	Estimated number of trees/ha	Host ^a	Average height of trees (m)	Leaders attacked (%)
<i>Atikokan District</i>					
Turtle Lake	12	4,000	jP	1.6	2.0
Windigoostigiwan Lake	8	5,000	jP	2.0	7.5
<i>Geraldton District</i>					
Burrows Lake (Crib Road)	50	2,500	bS	3.2	1.3
Clavet Township	25	1,600	wS	1.9	4.0
Exton Township	120	2,500	jP	2.6	0
Hanover Lake	20	2,000	wS	2.0	2.6
McPherson Seed Orchard	1.4	—	bS	5.8	3.3
McPherson Seed Orchard	1.4	—	wS	7.1	4.0
Rupert Township	75	3,500	jP	1.9	0
<i>Nipigon District</i>					
Ledger Township	20	2,000	jP	1.2	0
Ledger Township	15	2,500	bS	2.6	2.0
Limestone Lake	30	2,000	wS	3.5	6.0
Limestone Lake	75	4,000	bS	3.5	6.0
Obonga Lake			jP	2.7	8.0
<i>Terrace Bay District</i>					
Davies Township	8	1,600	wS	2.3	22.6
Deadhorse Road	10	1,600	wS	1.7	2.0
Deadhorse Road	50	3,000	jP	2.6	0
Grenville Township	10	2,000	bS	1.6	4.6
Roberta Township	10	1,100	wS	2.4	9.3
Roberta Township	7	1,100	bS	1.9	10.6
<i>Thunder Bay District</i>					
Albert Nikulasson Seed Orchard	10	—	bS	0.6	1.7
Bluebird Lake	5	2,500	jP	1.3	4.0
Boreal Road	5	2,000	bS	1.7	9.0
Burchell Lake	10	3,000	jP	2.3	16.5
English River	20	2,500	jP	2.1	7.0
Fallscamp Lake	5	2,500	jP	1.3	4.5
Grew River Road	5	2,500	jP	1.5	7.0
Grew River Road	5	2,500	bS	0.8	6.5
Kakabeka Falls	15	3,730	jP	1.2	2.0
O'Connor Seed Orchard	5	—	bS	2.2	1.3
Pace Lake	5	2,800	jP	1.2	6.0
Raith Family Test	5	2,500	jP	1.2	10.5

^a bS = black spruce, jP = jack pine, wS = white spruce.

Spearmarked Black Moth,
Rheumaptera hastata (L.)

Infestations by the spearmarked black moth in 1990 were confined to the southeastern portion of Quetico Park, Atikokan District. In 1991, this

infestation declined from 9,000 ha to 4,425 ha; however, there were 16,965 ha of newly infested areas recorded in the adjacent southwestern portion of Thunder Bay District. The total area of moderate-to-severe defoliation of white birch in

1991 was 21,390 ha (Fig. 6). The intensity of the infestation also decreased in Atikokan District, although most areas sustained less than 50%

defoliation. The defoliation rate averaged 70% in infested areas of Thunder Bay District.

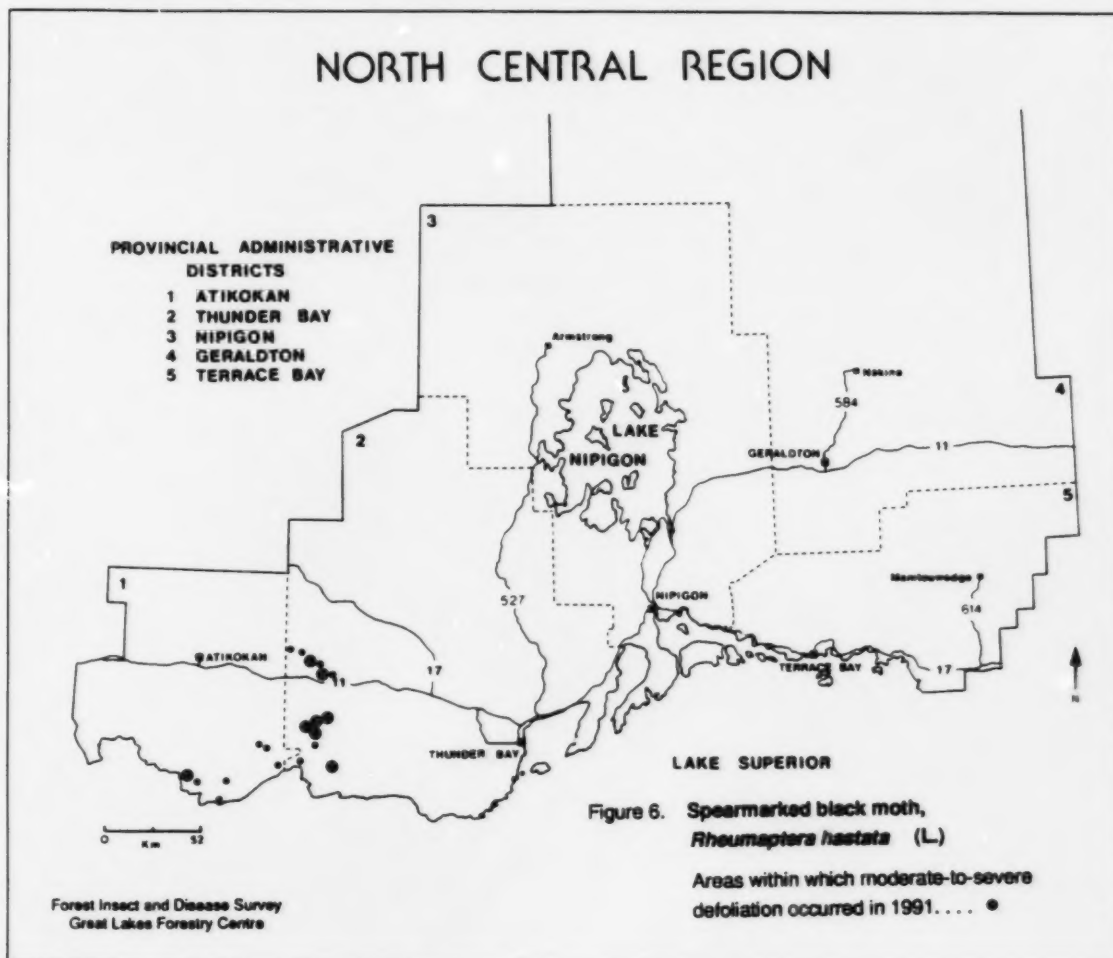


Table 10. Other forest insects.

Insect	Host(s)	Remarks
<i>Acantholyda erythrocephala</i> (L.) Pine false webworm	wP, rP, jP	There was an increased incidence of this insect in the city of Thunder Bay and surrounding rural areas. Foliar damage as high as 100% was observed on some trees.
<i>Alsophila pomataria</i> (Harr.) Fall cankerworm	mM	An average of 70% foliar damage occurred in the Town of Atikokan, Atikokan District, and 80% defoliation occurred in Paipoonge Twp, Thunder Bay District.

(cont'd)

Table 10. Other forest insects (concl.).

Insect	Host(s)	Remarks
<i>Aphrophora cribrata</i> (Wlk.) Pine spittlebug	jP	A 5-ha plantation of 3.5-m trees was 44% affected along Flynn Road, Geraldton District.
<i>Archips cerasivorana</i> (Fitch) Uglynest caterpillar	cCh	There were pockets of 100% defoliation in Sibley, Devon, Hartington and Fraleigh townships, Thunder Bay District.
<i>Archips negundana</i> (Dyar) Larger boxelder leafroller	mM	Widespread defoliation averaging 65% occurred in the city of Thunder Bay.
<i>Bucculatrix canadensisella</i> Cham. Birch skeletonizer	wB	Light damage was evident at a few locations in the Nipigon and Geraldton districts.
<i>Caloptilia invariabilis</i> (Braun) Cherry leafcone caterpillar	cCh	Defoliation averaging 5% was recorded in the Limestone Lake area of Nipigon District.
<i>Choristoneura conflictana</i> (Wlk.) Large aspen tortrix	tA	Light (5%) foliar damage was noted in the Hays Lake area, Terrace Bay District.
<i>Conophthorus resinosae</i> Hopk. Jack pine tip beetle	jP	In Ledger Twp, Nipigon District, 36% of the trees in a 5-ha plantation were affected.
<i>Dioryctria reniculelloides</i> Mut. & Mun. Spruce coneworm	bS	This pest accounted for an estimated 30% of the budworm-coneworm larval population in the Brightsands area, Thunder Bay District.
<i>Hyphantria cunea</i> (Drury) Fall webworm	deciduous trees	As many as 40 colonies per kilometre of roadside were found in O'Connor Twp, Thunder Bay District.
<i>Malacosoma californicum pluviale</i> (Dyar) Northern tent caterpillar	deciduous trees	This insect was common in many areas of the region, with defoliation ranging from 30 to 100%.
<i>Monochamus</i> sp. Sawyer beetle	jP, wS	Damage from adult feeding killed trees on a total of 35 ha of jack pine in several areas in the Atikokan, Thunder Bay and Geraldton districts. Damage to white spruce at the Mattawin Seed Orchard, Thunder Bay District, amounted to 16% branch mortality on 18% of the trees.
<i>Neodiprion maurus</i> Roh. Pine sawfly	jP	Low population levels caused 5% foliar damage on scattered trees in McQuesten Twp, Geraldton District.
<i>N. pratti banksianae</i> Roh. Jack pine sawfly	jP	Foliar damage of 5 and 40% was reported at locations in the Geraldton and Atikokan districts, respectively.
<i>Petrova albicapitana</i> (Bsk.) Northern pitch twig moth	jP	A 3-ha plantation of 1.3-m trees was 23% affected in Cecil Twp, Terrace Bay District.
<i>Phyllonorycter ontario</i> (Free.) Aspen leafblotch miner	tA	Foliar damage ranging from 50 to 100% occurred at various locations in the southern part of Thunder Bay District and in the Nipigon and Geraldton districts.
<i>Pristiphora geniculata</i> (Htg.) Mountain-ash sawfly	aMo	Varying degrees of defoliation were recorded at numerous locations in the Thunder Bay, Nipigon and Terrace Bay districts.
<i>Sparganothis acerivorana</i> MacK. Maple leafroller	rM	In the Turtle Lake and Flanders area of Atikokan District, defoliation averaged 10%.

DISEASES

Major Diseases

Armillaria Root Rot,

Armillaria ostoyae (Romagn.) Herink

Results obtained from evaluations carried out throughout the region in 1991 indicate that the incidence of this root rot was generally low. Of 24 jack pine, white spruce and black spruce plantations surveyed, 15 showed no evidence of *Armillaria*. The highest incidence of mortality was recorded at the Bluebird Lake Family Test site, Thunder Bay District, where 13% of the 1.3-m jack pine were dead. In the same district, 6% of the 1.2-m jack pine and 4% of the 1.3-m jack pine died at the Raith and Fallscamp Lake family-test sites, respectively. In McQuesten Township, Geraldton District, a 2-ha block of 1.9-m jack pine had 4% mortality.

Scleroderris Canker,

Gremmeniella abietina (Lagerb.) Morelet

Ongoing surveys conducted in 1991 revealed the presence of the North American race of this fungus at five different locations. The highest incidence was recorded in Strey Township, Terrace Bay District, where 38% of the 3.5-m jack pine were affected. In Cecil Township, Terrace Bay District, a 25-ha plantation had 24% of the 3.8-m jack pine affected. In the Lukinto Lake area of Geraldton District, a 50-ha plantation had 28% of the 4.5-m jack pine affected, including 6% with stem cankers. Near the Namewaminikan River in Nipigon District, 12.6% of the 4.3-m jack pine were affected. In Neys Provincial Park, Terrace Bay District, about 60% of the scattered natural regeneration of red pine (*Pinus resinosa* Ait.) were infected in one open area.

Minor Diseases

Pine Needle Rust,

Coleosporium asterum (Dietel) Sydow

The eastern part of Geraldton District in the Flynne Creek area is still the area in which the main

concentration of this disease occurs on jack pine within the region. A 5-ha plantation along the eastern end of Flynne Road had 59% of the 3.5-m trees affected, with an average of 3.6% foliar damage. Along Batiste Lake Road in the same area, a 5-ha plantation had 60% of the 2-m trees affected, with 5% foliar damage. In Terrace Bay District, along the Lemay Road, a 7-ha plantation of 3-m trees had 20% foliar damage on 100% of the trees. At one location in Lyon Township, Nipigon District, 10% of the 3.3-m trees had 20% defoliation.

Tar Spot Needle Cast,

Davisonmycelia ampla (J. Davis) Darker

This foliar disease was sampled at six jack pine locations in 1991. In the Boxer Lake area of Nipigon District, a 20-ha plantation had 41% of the trees affected, with 7% foliar damage. In the same district, 3.5-m trees in Lyon Township were affected, with 25% defoliation. In Geraldton District, along Highway 625, a 4-ha plantation averaged 20% foliar damage, and in Cecil Township, Terrace Bay District, a 25-ha plantation had 22% of the trees affected, with 19% foliar damage. At the Raith Family Test site in Thunder Bay District, 2% of the trees were infected, with 8% foliar damage, and in Atikokan District, the most significant damage occurred in a 2.5-m plantation east of Perch Lake, where 20% of the trees were affected, with 30% foliar damage.

Western Gall Rust,

Endocronartium harknessii

(J.P. Moore) Y. Hirats.

Surveys revealed that this disease was common on jack pine throughout the region in 1991 (Table 11). The highest incidences recorded were as follows: in Geraldton District, along Highway 625, 23.3% of the trees in a 4-ha plantation of 3.2-m trees were affected, and in Exton Township, 22% of the trees in a 3-ha plantation of 5.1-m trees were affected, with 4% having stem galls. In Cecil Township, Terrace Bay District, 20% of the 1.3-m trees in a 3-ha plantation were affected.

Table 11. Damage to jack pine caused by western gall rust in the North Central Region of Ontario in 1991 (counts based on an examination of 150 trees at each location).

Location	Area affected (ha)	Estimated number of trees/ha	Average tree height (m)	Trees affected (%)	Trees severely affected (%)
<i>Atikokan District</i>					
Alcona	1.0	2,500	25	100	20
Sapawe-Upsala Road	25	4,500	2.9	7.0	4.0
<i>Geraldton District</i>					
Exton Township	3	1,600	5.1	22.0	4.0
Flynne Lake	5	3,000	2.4	0	0
Highway 625	4	1,600	3.2	23.3	2.0
Lukinto Lake	50	2,500	4.5	16.6	8.6
McQuesten Township	2	1,600	2.7	7.3	2.6
Rupert Township	60	2,500	1.5	0	0
<i>Nipigon District</i>					
Ledger Township	5	3,500	3.8	0	0
Nomeawaminikan River	20	2,500	4.3	1.6	0.7
Lyon Township	5	4,000	3.3	5.0	2.0
<i>Terrace Bay District</i>					
Cecil Township	3	2,000	1.3	20.0	3.3
Cecil Township	25	1,600	3.8	6.6	0.7
Strey Township	35	4,000	3.1	4.0	0.7
<i>Thunder Bay District</i>					
Bluebird Lake	5	2,500	1.3	7.0	4.0
Fallscamp Lake	5	2,500	1.3	4.5	1.0
Raith Family Test	5	2,500	1.2	1.0	0

Table 12. Other forest diseases.

Disease	Host(s)	Remarks
<i>Chrysomyxa arctostaphyli</i> Dietel Spruce broom rust	wS	In Pic Twp, Terrace Bay District, 20% of the trees were affected in an open-grown semimature stand.
<i>Chrysomyxa ledicola</i> Peck Lagerh.	bS,	Infection levels declined considerably from previous years. In
<i>Chrysomyxa ledi</i> (Alb. & Schwein.) de Bary var. <i>ledi</i> and var. <i>cassandrae</i> (Peck & G.P. Clinton) Saville Spruce needle rusts	wS	Roberta Twp, Terrace Bay District, a 6-ha 1.8-m black spruce plantation had 10% foliar damage. Trace defoliation levels were found at other locations.
<i>Ciborinia whetzelii</i> (Seaver) Seaver Ink spot of aspen	LA	In Bomby Twp, Terrace Bay District, 0.5 ha of trembling aspen had 40% foliar damage.
<i>Cronartium ribicola</i> J.C. Fischer White pine blister rust	wP	An infection rate of 9%, with 6% of trees severely affected, occurred on 1.5-m trees in Lyon Twp, Nipigon District. In Neys Provincial Park, Terrace Bay District, six trees were affected, with one dead and another dying.

(cont'd)

Table 12. Other forest diseases (concl.).

Disease	Host(s)	Remarks
<i>Hypoxylon mammatum</i> (Wahlenb.) P. Karsten Hypoxylon canker	tA	Three young trees were affected along the Anaconda Road, Geraldton District.
<i>Mycosphaerella populicola</i> G.E. Thompson Septoria leaf spot	bPo	This leaf spot was common across the work area in 1991, with many stands averaging 65% defoliation.
<i>Sphaeropsis sapinea</i> (Fr.) Dyko & B. Sutton Diplodia tip blight	rP	An average of 10% shoot kill occurred on 60% of the 12-m trees at French Lake, Atikokan District.
<i>Venturia maculans</i> (Fr.: Fr.) E. Müller & v. Arx Shoot blight	tA	In Wiggins Twp, Terrace Bay District, 0.5 ha of regeneration had 20% leader damage. In Nipigon District, along the Onaman Lake Road, a number of young aspen had 70% shoot damage.

ABIOTIC DAMAGE

Ash Dieback

Ash dieback, an abiotic condition, was recorded on black ash (*Fraxinus nigra* Marsh.) in the southeastern part of Thunder Bay District in 1991. A total gross area of 764 ha in a number of separate areas was delineated by aerial and ground surveys. The damaged areas are in Scoble, Paipouge, Blake and Neebing townships. Drought conditions in previous growing seasons may have been responsible for the dieback.

Drought

Drought conditions and the resultant damage to trees occurred over much of the region during the summer of 1991, following a very dry July and August. Except for isolated rains, the dry conditions prevailed from the first week of July to mid-August. The total precipitation at the Thunder Bay Airport was only 60% of the normal for August, and at the Geraldton weather station rainfall was below normal for four consecutive months: June (54%), July (30%), August (31%) and September (78%) (Table 16).

The damage was most evident on hillsides, mesa tops, ridges and along highway rockcuts; in general, it occurred where rocky sites and shallow soils predominated. The most striking symptom of the damage was discoloration of foliage of the deciduous species. In early August, white birch leaves

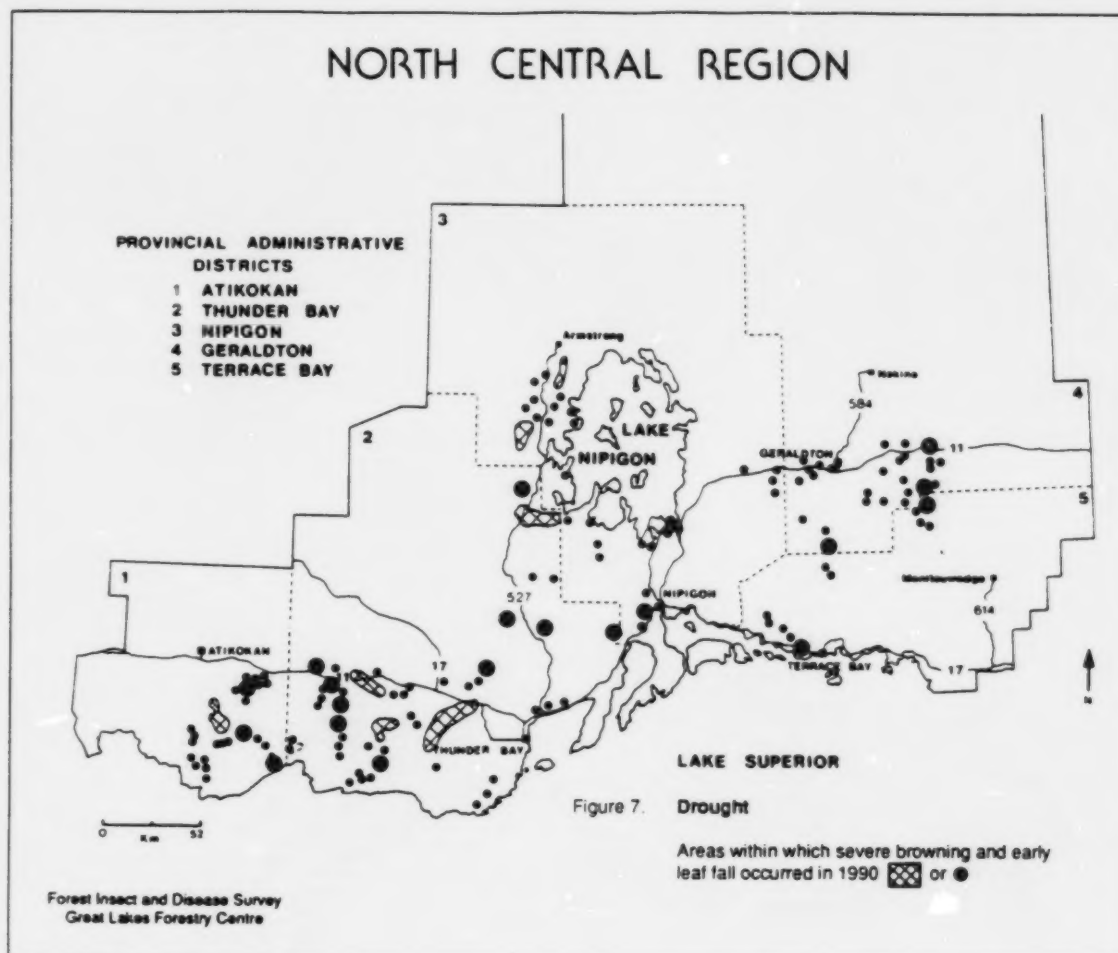
turned yellowish and then brownish. By the end of August, hardwoods in the most heavily affected areas were completely denuded of foliage. The foliage of affected conifers turned reddish brown.

White birch was the most commonly affected host, but all hardwood tree and shrub species were susceptible to damage on these dry sites. Balsam fir and jack pine were occasionally affected. The drought damage occurred in large areas in some cases, but in other situations only small groups of trees or single trees were damaged. Figure 7 shows the areas that exhibited the most severe symptoms.

FOREST HEALTH

Acid Rain National Early Warning System (ARNEWS)

The three ARNEWS plots in North Central Region are part of a national network of such plots designed to monitor symptoms of damage from air pollutants, particularly acid precipitation. In addition, trees in these plots are evaluated with respect to the level, extent and intensity of any insect or disease problems. No damage that could be attributed to airborne pollutants was detected at any of the three plots in 1991. As in previous years, spruce budworm damage was by far the biggest problem. In Wiggins Township, Terrace Bay District, defoliation by spruce budworm averaged 65% on white spruce and 20% on black spruce; at Margo Lake in Geraldton District, damage levels averaged



65% on the black spruce. In Fowler Township, Thunder Bay District, defoliation averaged 75% on the balsam fir and 18% on black spruce.

Additional problems encountered included a recurring presence of western gall rust in the Margo Lake plot; trace levels of spruce needle rust in Fowler Township; and some new mortality as a result of windthrow from a storm in 1989 in the Wiggins Township plot.

White Birch Health

In 1989, the Ontario Ministry of the Environment expressed concern about birch dieback in some areas of Ontario, and a co-operative program was begun to monitor the apparent decline of white

birch. The study began by setting up 100-tree plots in stands already showing some degree of dieback. In North Central Region, a plot was established in Lahontan Township, Terrace Bay District, along Highway 17 just west of Rainbow Falls Provincial Park. This is a mixed-age stand showing only a minimal degree of dieback, and provided a good opportunity for ongoing monitoring. Table 13 shows the number of trees that experienced dieback from 1989 to 1991, expressed as a cumulative total. The most common problem encountered was the target canker (*Nectria* sp.), which affected 6% of the trees. The clinker conk (*Inonotus obliquus* [Pers.:Fr.] Pilát) affected 3% of the trees, and 2% of the trees had died since the 1990 evaluation.

Table 13. Birch health at one location in the North Central Region of Ontario from 1989 to 1991, based on an examination of 100 trees.

Location	Average height (m)	Average DBH (cm)	Cumulative dieback class ^a					
			0	1	2	3	4	5
			←———— Number of trees —————→					
<i>Terrace Bay District</i>								
Lahontan Township								
1989	14.2	24.3	74	22	2	1	1	0
1990			69	25	3	1	2	0
1991			88	8	1	1	0	2

^a Class 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >60%, 5 = dead

SPECIAL SURVEYS

Gypsy Moth,

Lymantria dispar (L.)

The gypsy moth pheromone trapping program, designed to attract and capture male moths of this species as an aid in monitoring the spread of this insect, was repeated in 1991. All nine provincial parks in the region, as well as Inwood Township Park near Upsala, Thunder Bay District, were monitored this year. Two traps are deployed at each park with the exception of French Lake, Quetico Park, Atikokan District, where 10 traps were used. At this location, a collection was made in 1990, indicating a need for more intensive sampling this year.

Results were negative at all locations in 1991 except at the French Lake site. Here, for the second consecutive year, a single male moth was collected.

Forest Tree Nursery Report

A number of visits were made to the Thunder Bay Forest Tree Nursery during the 1991 growing season to examine seedlings and surrounding trees for the presence of biotic pests and damaging abiotic conditions.

The spruce budworm was very numerous again; however, timely spraying with the biological insecticide *B.t.* on spruce windbreaks, in the breeding orchard and in selected seedbeds reduced damage by this pest to low levels. Scattered areas of high numbers of the yellowheaded spruce sawfly on sapling-sized spruce hedgerow trees also necessitated control measures. The heaviest damage,

40% average defoliation, occurred on a group of twelve 3.0-m black spruce at one location.

The black cutworm (*Agrotis ipsilon* [Hufn.]) was collected and control measures were undertaken in several compartments. Pheromone traps for the black army cutworm (*Actebia fennica* [Tausch.]) were set out again this year and 132 adults were collected in three traps. The strawberry root weevil (*Otiorynchus ovatus* [L.]) was responsible for damage to newly transplanted spruce plugs. Up to 10% of the trees were affected.

June beetles (*Phyllophaga* sp., also called white grubs) caused an undetermined amount of rootlet damage as a result of larval feeding. Bio-Vector, a commercial biological insecticide whose active ingredient is an insect-parasitic nematode, was applied in a small area to control the grubs. The application was made in mid-August, so any beneficial results will not be evident until the spring of 1992.

The needle blight *Kabatina thujae* A. Schneider & v. Arx caused foliar, branch and whole-tree mortality to white cedar (*Thuja occidentalis* L.) seedlings in compartment 114. The heaviest damage occurred in a pocket within the compartment in which 75% of the 0.3-m trees were affected, with 25% foliar damage and 3% tree mortality.

In the adjacent breeding orchard, both white spruce and black spruce were affected to a minor degree by the spruce budworm and the yellow-headed spruce sawfly. Also on white spruce, frost damage caused 10% mortality of new shoots on

10% of the trees and there were also low levels of spruce needle rust. The white pine weevil infested 1.7% of the leaders on black spruce. A sample of black spruce cones revealed that 44% were infested by the fir coneworm (*Dioryctria abietivorella* [Gr.]).

Seed Orchard Survey

This survey, initiated in 1990, was repeated during the 1991 field season. Two visits, each timed to coincide with early- and late-season pest problems, were made to four black spruce seed orchards and two white spruce seed orchards in the region. White spruce and black spruce were both examined at the Pearson Township seed orchard, Thunder Bay District, and at the James Angus McPherson seed orchard, Geraldton District. At the Partridge Falls and Mattawin seed orchards, both in Thunder Bay District, only black spruce was examined as part of this year's formal survey. All orchards were examined for *Armillaria* root rot, spruce needle rust, *Diplodia* tip blight and spruce cone rust (*Chrysomya pirolata* [Köm.] Winter) as well as for frost damage and chlorosis. Damaging insects that were specifically sought included the spruce budworm, the spruce coneworm, shootworms (*Zeiraphera* spp.) and the white pine weevil

(Tables 14, 15). Damage from any other agents encountered during the survey was also recorded.

There was little incidence of disease organisms in these seed orchards in 1991. Black spruce at the Mattawin site had a 100% infection rate by spruce needle rust but only averaged 2% foliar damage. Chlorotic black spruce trees were encountered at the Partridge Falls location (13.3%) and on white spruce at the Pearson orchard (0.7%).

The spruce budworm was the most common insect observed, and was recorded at all locations. The heaviest damage (39% defoliation) occurred on white spruce at the McPherson orchard. The yellowheaded spruce sawfly was reported in three areas, with the most severe damage occurring at the Mattawin location, where 10% of the trees averaged 20% foliar damage and a single tree died as a result of heavy feeding by the sawfly in 1990. The white pine weevil occurred on both spruces at the McPherson location and the spruce coneworm was only recorded on black spruce at the Pearson orchard. The only other insects recorded were the spruce gall adelgid (*Adelges lariciatus* [Patch]), which occurred on 9.3% of the white spruce at the McPherson orchard, and mound ants (*Formica* sp.), which were responsible for 0.7% mortality of white spruce at the Pearson orchard.

Table 14. Damage detected in a special survey of black spruce seed Orchards in 1991 in the North Central Region of Ontario (percentages based on an examination of 150 trees at each location).

	District and orchard			
	Geraldton McPherson	Thunder Bay Pearson	Thunder Bay Partridge Falls	Thunder Bay Mattawin
Average height (m)	5.8	2.3	0.4	4.6
Area (ha)	1.4	1.0	16.0	5.0
Spruce budworm: trees affected (%)	100	100	37.3	100
Spruce coneworm: trees affected (%)	0	67	0	0
Defoliation by budworm/coneworm (%)	26.0	8.0	10.0	22.0
<i>Zeiraphera</i> spp.: trees affected (%)	0	0	0	0
Yellowheaded spruce sawfly: trees affected (%)	0	6.0	0	10.0
defoliation (%)	0	18.0	0	20.0
White pine weevil: leaders affected(%)	3.3	0	0	0
Frost injury: trees affected (%)	0	0	0	0
<i>Armillaria</i> root rot: trees affected (%)	0	0	0	0
Needle rust: trees affected (%)	0	0	0	100
foliar damage (%)	0	0	0	2.0
<i>Diplodia</i> tip blight: trees affected (%)	0	0	0	0
Cone rust: trees affected (%)	0	0	0	0

Table 15. Damage detected in a special survey of white spruce seed orchards in 1991 in the North Central Region of Ontario (percentages based on an examination of 150 trees at each location).

	District and orchard	
	Geraldton McPherson	Thunder Bay Pearson
Average height (m)	7.1	3.9
Area (ha)	1.4	1.0
Spruce budworm: trees affected (%)	100	100
Spruce coneworm: trees affected (%)	0	0
Defoliation by budworm/coneworm (%)	39.0	10.0
<i>Zeiraphera</i> spp.: trees affected (%)	0	0
Yellowheaded spruce sawfly: trees affected (%)	0	6.7
defoliation (%)	0	8.0
White pine weevil: trees affected (%)	4.0	0
Frost injury: trees affected (%)	0	0
Armillaria root rot: trees affected (%)	0	0
Needle rust: trees affected (%)	0	0
Diplodia tip blight: trees affected (%)	0	0
Cone rust: trees affected (%)	0	0

Climatic Data

Atmospheric conditions, both natural and man-made, can have devastating effects on forest trees. For example, there were three reports of tree damage in 1990 in North Central Region that resulted from adverse weather conditions, namely

blowdown, frost damage and winter drying. In 1991, the condition that caused the most widespread damage was drought. Because of the importance of weather in forest health, temperature and precipitation records for two weather stations in the region are listed in Table 16.

Table 16. Climatic data for two weather stations in the North Central Region of Ontario in 1991.

Location	Month	Mean temperature (°C)		Deviation from normal (°C)	Total precipitation (mm)		Deviation from normal (%)
		Actual	Normal		Actual	Normal	
Thunder Bay Airport	January	-17.2	-15.4	-1.8	26.4	40.9	-35
	February	-9.9	-13.0	+3.1	14.0	28.3	-50
	March	-5.1	-6.3	+1.2	52.6	45.0	+17
	April	4.8	2.5	+2.3	68.8	50.7	+36
	May	11.0	8.8	+2.2	67.6	73.3	-8
	June	16.1	14.0	+2.1	78.5	76.6	+2
	July	17.4	17.6	+0.2	72.4	75.4	-4
	August	18.3	16.4	+1.9	33.4	83.1	-60
	September	10.2	11.1	-0.9	98.5	89.1	+11
	October	3.4	5.7	-2.3	71.7	54.8	+31
	November	-5.4	-2.6	-2.8	106.4	52.9	+101
	December	-10.3	-11.1	+0.8	35.6	41.1	-13
Geraldton Airport	January	-22.1	-20.0	-2.1	29.8	38.2	-22
	February	-13.8	-17.9	+4.1	10.6	33.3	-68
	March	-3.8	-11.0	+7.2	34.0	38.2	-11
	April	+3.5	-0.5	+4.0	57.0	43.3	+32
	May	11.1	7.7	+3.4	73.4	63.2	+16
	June	16.7	13.5	+3.2	42.2	91.9	-54
	July	17.0	16.3	+0.7	57.0	81.6	-30

(cont'd)

Table 16. Climatic data for two weather stations in the North Central Region of Ontario in 1991 (concl.).

Location	Month	Mean temperature (°C)		Deviation from normal (°C)	Total precipitation (mm)		Deviation from normal (%)
		Actual	Normal		Actual	Normal	
Geraldton	August	16.8	14.6	+2.2	46.2	66.8	-31
Airport	September	8.4	9.3	-0.9	16.4	75.6	-78
(concl.)	October	0.7	3.9	-3.2	94.2	64.6	+33
	November	-7.2	-5.5	-1.7	104.0	61.5	+69
	December	-14.5	-15.4	+0.9	28.2	38.8	-27

APPENDIX: North Central Region – Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1991, and infestation forecasts for 1992.

Location	Host	Estimated defoliation in 1991 (%)	Number of egg masses per 9.29 m ² of foliage	Infestation forecasts for 1992 ^a	Accumulated damage ^b
<i>Atikokan District</i> (16 locations)					
Agnes Lake	bF	78	376	S	8
Basswood Lake – Prairie Portage	bF	24	292	S	5
Burton Lake	bF	3	121	M-S	-
Cache Bay	bF	8	37	L-M	+
Clearwater West Lake	bF	3	15	L-M	-
French Lake	bF	25	105	M-S	8
Irene Lake	bF	65	146	M-S	5
Joe Lake	bF	3	128	M-S	-
Kawa Bay	bF	11	23	L-M	+
Lerome Lake	bF	58	652	S	6
Little Eva Lake	bF	84	906	S	8
Lizard Lake	bF	24	257	S	7
Oriana Lake	bF	45	10	L	7
Poohbah Lake	bF	68	491	S	8
Tuck Lake	bF	91	216	S	7
Van Nostrand Lake	bF	41	471	S	8
<i>Geraldton District</i> (41 locations)					
Ashmore Township	bF	98	735	S	2
Bain Township	bF	93	466	S	2
Boyce Township	bF	80	649	S	1
Calong Lake – plot 1 ^d	wS	95	715	S	1
– plot 2 ^d	bF	55	166	M-S	1
Caramat Road – 2.8 km south of Highway 11	bF	95	866	S	2
Catlonite Road – km 115.7	bF	90	288	S	5
– Spider Lake	bF	48	61	M-S	2
Esnagami Lake	bF	93	318	S	2
Fernow Lake – plot 1 ^d	bF	59	106	M-S	1
– plot 2 ^d	bF	38	367	S	1
– check plot	bF	72	666	S	1
Fleming Lake	bF	93	446	S	2
Florrie Road	wS	66	455	S	1
Goldfield Road – Kenogamisis River	bF	81	320	S	2
– Rogers Lake	bF	64	615	S	3
– Wig Lake	bF	37	515	S	2
Goodwin Township	bF	80	74	M-S	1
Hollowrock Lake – plot 1 ^d	bF	88	182	M-S	1
– plot 2 ^d	wS	93	286	S	1
– check plot	bF	92	205	M-S	1
– check plot	wS	92	464	S	1
– check plot	bF	87	221	S	1
– check plot	wS	92	508	S	1
Highway 84 – Burrows Lake	bF	87	1,351	S	2

(cont'd)

APPENDIX: North Central Region – Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1991, and infestation forecasts for 1992 (cont'd).

Location	Host	Estimated defoliation in 1991 (%)	Number of egg masses per 9.29 m ² of foliage	Infestation forecasts for 1992 ^a	Accumulated damage ^b
<i>Geraldton District (concl.)</i>					
Industrial Road – south of Caramat	bF	78	374	S	2
Jemar Lake	bF	73	277	S	1
Kimberly – Clark SPA ^c	wS	26	748	S	1
Kirby Township	bF	89	235	S	2
Klotz Lake Prov. Park	bF	95	1,124	S	2
Long Lake – West Side	bF	53	250	S	2
Meta Lake	bF	57	753	S	1
Nakina Township	bF	73	307	S	2
Nibs Lake – Impact Plot	bF	93	488	S	7
Oly Lake – plot 1 ^d	wS	84	264	S	1
– plot 2 ^d	wS	66	255	S	1
– check plot	wS	66	0	N	1
O'Meara Township	wS	81	420	S	2
Pagwachuan Lake – southwest	bF	93	657	S	2
– northeast	bF	93	775	S	2
Wintering Lake	bF	95	296	S	5
<i>Nipigon District (69 locations)</i>					
Altitude Lake	bF	70	456	S	2
Barbara Lake – Block 38, Plot 1 ^d	bF	91	310	S	2
– Block 38, Plot 2 ^d	bF	71	43	L-M	2
– Block 38, Plot 3 ^d	bF	74	141	M-S	2
– check plot	bF	72	1,133	S	3
Black Bay – Block 17 ^d	bF	6	13	L	2
	wS	10	27	L-M	2
– Block 17 – northeast ^d	bF	8	0	N	2
– Block 18 ^d	bF	8	0	N	2
– Block 19 ^d	bF	48	147	M-S	3
	wS	64	442	S	3
Black Sturgeon Lake – Block 8, plot 1 ^d	bF	19	78	M-S	2
	wS	32	136	M-S	2
– Block 8, plot 2 ^d	bF	12	17	L-M	2
	wS	22	24	L-M	2
– Block 10, plot 1 ^d	bF	12	130	M-S	2
	wS	31	253	S	2
– Block 10, plot 2 ^d	bF	52	43	L-M	2
	wS	78	58	M-S	1
– Check Plot	bF	42	63	M	2
	wS	65	140	M-S	1
Booth Township – Parmachene	bF	56	71	M-S	6
Camp 75 Road	bF	79	481	S	3
Central Lake	bF	93	0	N	2
Corrigal Township – Highway 17	wS	42	709	S	2
Cosgrove Lake	bF	86	272	S	2

(cont'd)

APPENDIX: North Central Region – Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1991, and infestation forecasts for 1992 (cont'd).

Location	Host	Estimated defoliation in 1991 (%)	Number of egg masses per 9.29 m ² of foliage	Infestation forecasts for 1992 ^a	Accumulated damage ^b
<i>Nipigon District (concl.)</i>					
Frank Lake	bF	66	486	S	2
Gurney Lake	bF	83	279	S	5
Highway 527 – Gull River	bF	30	101	M-S	4
– Kopka River	bF	53	382	S	5
– Waweig Lake	bF	69	1,280	S	5
Innes Township	bF	42	196	M-S	5
Jean Lake – Block 39 ^d	bS	17	0	N	1
– Block 40 ^d	wS	90	611	S	1
Kilkenny Township					
– Lake Nipigon Prov. Park ^d	bF	18	0	N	3
	wS	44	135	M-S	3
Limestone Lake – Block 24, plot 1 ^d	wS	2	33	L-M	2
– Block 24, plot 2 ^d	wS	2	0	N	2
– Block 25, plot 1 ^d	wS	6	0	N	1
– Block 25, plot 2 ^d	wS	11	62	M-S	2
– check plot 1	wS	5	38	L-M	2
– check plot 2	wS	4	34	L-M	2
North Lamaune Lake	bF	48	301	S	1
Northwind Lake – Block 60, plot 2 ^d	bF	8	240	M-S	2
	wS	8	129	M-S	2
– Block 63, plot 1 ^d	bF	12	10	L	2
	wS	6	60	M-S	2
– check plot	bF	78	179	M-S	2
	wS	91	515	S	2
Obonga Lake	bF	36	82	M-S	5
Onaman Lake – south	bF	89	95	M-S	2
– north	bF	78	639	S	1
Onaman River	bF	92	219	S	2
Oskawe Lake	bF	32	1,113	S	5
Parks Lake	bF	89	231	S	3
Patience Township	bF	12	109	M-S	2
Polly Lake – Impact Plot	bF	34	91	M-S	5
Shillabeer Creek	bF	42	99	M-S	7
Spool Lake	bF	90	40	L-M	2
Summers Township – north of Beardmore	bF	93	383	S	3
– south of Beardmore	bF	90	110	M-S	2
Tyrol Lake – Block 56, plot 2 ^d	wS	64	124	M-S	2
– Block 56, plot 3 ^d	wS	55	278	S	2
– check plot	wS	48	275	S	2
Upper Roslyn Lake	bF	94	135	M-S	5
Windigokan Lake – Block 45 ^d	bF	5	94	M-S	2
	wS	16	52	L-M	2
– Block 46 ^d	bF	13	109	M-S	3
	wS	68	0	N	2

(cont'd)

APPENDIX: North Central Region – Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1991, and infestation forecasts for 1992 (cont'd).

Location	Host	Estimated defoliation in 1991 (%)	Number of egg masses per 9.29 m ² of foliage	Infestation forecasts for 1992 ^a	Accumulated damage ^b
<i>Terrace Bay District (48 locations)</i>					
Barbara Lake – SPA ^c	wS	55	769	S	1
Beavercross Lake – plot 4 ^d	bF	90	75	M-S	1
	wS	95	74	M-S	1
– plot 5 ^d	bF	95	8	M-S	1
	wS	78	112	M-S	2
– check plot 1	bF	93	273	S	2
	wS	95	709	S	1
– check plot 2	bF	89	434	S	2
	wS	78	277	S	1
Big Duck Lake	bF	21	90	M-S	2
Blue Jay Lake	bF	88	1,526	S	3
Callonite Road – km 46.7	bF	26	156	M-S	3
Cirrus Lake	bF	93	321	S	5
Cornish Lake	bF	9	102	M-S	5
Dead Otter Lake	bF	40	227	S	1
Deutzia Lake	bF	71	335	S	5
Fakeloo Lake	bF	92	425	S	2
Foxtrap Lake	bF	17	53	M	2
Garnham Lake	bF	83	503	S	2
Gertrude Township – Morley Lake Road	bF	93	761	S	1
Gowan Lake	bF	50	300	S	5
Greenhedge Lake	bF	21	163	M-S	3
Highway 614 – Stand 360	bF	84	776	S	2
Industrial and Camp 15 Road	bF	83	460	S	2
Kagiano Lake	bF	84	743	S	4
Killala Lake	bF	83	290	S	3
Killraine Township					
– Rainbow Falls Prov. Park	bF	28	0	N	1
Leslie Township	bF	76	128	M-S	2
Little Nama Creek	bF	94	495	S	1
Lola Lake	bF	90	206	M-S	2
McCoy Township	bF	8	0	N	1
Neys Prov. Park	bF	48	166	M-S	3
Nickle Township	bF	63	783	S	1
Osawin Lake	bF	94	620	S	1
Otasawian Lake	bF	77	382	S	1
Pearly Lake	bF	93	1,039	S	3
Pic Township – Black River	wS	6	0	N	0
– Pukaskwa Park Headquarters	wS	7	10	L	1
Portage Lake	wS	40	294	S	2
Rocke Lake	bF	76	46	L-M	5
Steel Lake	bF	26	161	M-S	2
Stevens – Microwave Tower	bF	94	956	S	2

(cont'd)

APPENDIX: North Central Region – Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1991, and infestation forecasts for 1992 (cont'd).

Location	Host	Estimated defoliation in 1991 (%)	Number of egg masses per 9.29 m ² of foliage	Infestation forecasts for 1992 ^a	Accumulated damage ^b
<i>Terrace Bay District (concl.)</i>					
Syline Township	bF	28	0	N	2
	wS	10	61	M	2
Vein Lake	bF	95	1,885	S	3
Wiggins Township	bF	68	90	M-S	3
– Stand 90	bF	56	11	L	6
– Stand 90	wS	69	320	S	4
<i>Thunder Bay District (87 locations)</i>					
Abigogami Lake – Block 9, Plot 1 ^d	bF	13	0	N	1
	wS	43	44	L-M	2
– Block 9, Plot 2 ^d	bF	28	0	N	2
	wS	77	0	N	2
– check plot	bF	30	496	S	2
	wS	33	96	M-S	2
Abitibi Price – Camp 11	bF	68	432	S	3
Abitibi Price – Camp 230	bF	73	1,371	S	3
Aldina Township – Impact Plot, Stand 19	bF	30	565	S	8
Bedivere Lake	bF	18	110	M-S	7
Blackwell Township	bF	22	431	S	7
Bo Lake	bF	28	229	S	3
Brightsand Lake	bF	69	729	S	5
Burchell Lake – Stand 125	bF	7	0	N	–
Camp 45 Road	bF	88	472	S	5
Cheeseman Lake – km 130	bF	19	156	M-S	8
	wS	78	652	S	8
Conacher Township – Stand 459	bF	47	401	S	8
Crayfish Lake	bF	46	277	S	6
Devon Township	bF	24	47	L-M	6
Dorion Township – Plantation	wS	2	0	N	1
Forbes Township – Flett	bF	82	158	M-S	4
Fowler Township	bF	55	190	M-S	3
– Plantation	wS	60	710	S	1
Fraleigh Township – Block 4, Plot 1 ^d	wS	5	24	L-M	1
– Block 4, Plot 2 ^d	wS	7	52	M-S	1
– check plot	wS	12	0	N	1
Gorham Township – Hazelwood ^a	bF	31	81	M-S	2
– Wishart ^a	bF	58	166	M-S	1
Greenwater Lake – southeast	bF	9	0	N	–
– Shelter Island	bF	12	51	L-M	–
Greenwood Lake	bF	8	49	L-M	–
Grew River	bF	21	552	S	3
Hagey Township – Highway 586	bF	27	181	S	+
– Plantation	wS	7	29	L-M	1
Haines Township – Postans	bF	16	77	M-S	–
Harmon Lake	bF	76	366	S	6

(cont'd)

APPENDIX: North Central Region – Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1991, and infestation forecasts for 1992 (cont'd).

Location	Host	Estimated defoliation in 1991 (%)	Number of egg masses per 9.29 m ² of foliage	Infestation forecasts for 1992 ^a	Accumulated damage ^b
<i>Thunder Bay District (cont'd)</i>					
Hartington Township – Plantation	wS	32	567	S	1
Hicks Lake	bF	69	252	S	4
Hood Lake	bF	4	0	N	–
Hoof Lake	bF	19	120	M–S	–
Highway 11 – west of 802, Stand 590	bF	18	0	N	–
– west of 802, Stand 601	bF	15	25	L–M	–
Kabitotikwia Lake	bF	73	494	S	7
Kekekuab Lake	bF	43	435	S	–
Lac Des Mille Lacs – Bolton Bay	bF	44	60	M–S	6
– Honkonen Narrows	bF	27	186	M–S	6
Lismore Township	bF	22	160	M–S	5
Marks Township – Plantation	wS	5	51	L–M	1
Matawin Road – Tree Seed Orchard ^d	wS	9	15	L	1
McGinnis Lake	bF	6	50	L–M	–
McMaster Township – Block 15, Plot 1 ^d	bF	13	114	M–S	2
	wS	25	36	L–M	2
– Block 15, Plot 2 ^d	bF	10	278	S	2
	wS	11	112	M–S	2
– Block 15, Plot 3 ^d	bF	26	183	M–S	2
	wS	53	300	S	2
– check plot	bF	69	374	S	2
	wS	36	311	S	2
McTavish Township – Block 8 ^d	bF	75	354	S	1
Moss Lake	bF	11	0	N	–
Mountain Lake	bF	35	182	M–S	6
	wS	48	592	S	6
Mug Lake	bF	15	244	S	2
O'Connor Township – Cedar Falls ^e	bF	37	149	M–S	2
– OMNR SPA ^c	wS	19	22	L–M	1
Paipoonge Township – OMNR Nursery	wS	7	83	M–S	1
– check plot	wS	58	698	S	1
Pakashkan Lake – Outlet Bay	bF	89	1,043	S	4
Plummes Lake	bF	6	39	L–M	–
Sandstone Lake	bF	39	56	L–M	6
Savanne Township	bF	48	140	M–S	3
Shebandowan Lake	bF	11	N0	N	–
Sleeping Giant Provincial Park	bF	95	1,446	S	5
Sparkling Lake	bF	66	639	S	4
Squeers Lake	bF	8	16	L–M	–
Sump Lake	bF	39	1,165	S	6
Tib Lake	bF	44	263	S	2
Trewartha Township	bF	61	219	M–S	2
Wawang Lake	bF	39	860	S	4
Weaver Lake	bF	88	634	S	6

(cont'd)

APPENDIX: North Central Region – Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1991, and infestation forecasts for 1992 (concl.).

Location	Host	Estimated defoliation in 1991 (%)	Number of egg masses per 9.29 m ² of foliage	Infestation forecasts for 1992 ^a	Accumulated damage ^b
<i>Thunder Bay District (concl.)</i>					
Whitelily Lake – Highway 527	bF	55	247	S	2
Wolf River Road – km 28	bF	68	0	N	5
Wolf Lake – Block 5B ^d	wS	17	0	N	1
– Block 6 ^d	wS	5	0	N	1
– Block 6B ^d	wS	4	40	L–M	1
– check plot	wS	49	300	S	1

^a S = severe, M = moderate, L = light, N = nil

^b accumulated damage categories: 0 = undamaged; 1 = light damage, <25% total defoliation, usually one season of severe defoliation; 2 = moderate damage, 25% to 60% total defoliation, two or three seasons of severe defoliation; 3 = severe damage, 60% to 80% total defoliation, three to five seasons of severe defoliation, will recover; 4 = moribund or dying, 80% to 100% total defoliation, crowns grey in appearance, top dead or bare 50 to 150 cm; 5 = <25% of stand dead; 6 = 25 to 50% of stand dead; 7 = 50 to 70% of stand dead; 8 = more than 70% of stand dead; 9 = less than 25% of stand dead, no significant (0–25%) defoliation for several years; + = 25 to 50% of stand dead, no significant defoliation for several years; – = 51 to 70% of stand dead, no significant defoliation for several years.

^c Seed Production Area

^d Aerially sprayed with *B.t.* in 1991

^e Lakehead Region Conservation Authority